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ASSESSMENT OF HEAVY METALS POLLUTION IN SEDIMENTS OF UDHWA AND SIMULTALLA LAKES OF JHARKHAND

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Abstract: *The presence of heavy metals has detrimental effect on the flora and fauna present in water bodies such as ponds and lakes. Heavy metals interferes in many ways with the normal physiology of organisms and eventually changes the phenocopy of that ecosystem. In the present study two different lakes namely Udhwa Lake and Simultalla (Jharkhand) Lake were investigated for the estimation of four heavy metals viz. Fe, Cu, Zn and Mn. The lakes under investigation are natural lentic water bodies surrounded by crop fields, therefore source of heavy metals are both runoff water from inorganic fertilizer saturated crop fields and from the underground water having metal salts from the aquifer bed rocks. It was investigated that both lakes contains detectable level of heavy metals. The amount of Zn was found at normal level in Udhwa (0.86 ppm) and Simultalla (1.12ppm) lake respectively, while the amount of Fe, Cu and Mn were found high in comparison to reference value in both Udhwa and Simultalla Lakes. Comparatively Udhwa lake contains less amounts of Fe (18.37ppm), Cu (5.19 ppm) and Mn (8.16 ppm) with respect to Simultalla lake Fe (21.66 ppm), Cu (6.07 ppm) and Mn (13.00 ppm) respectively.*

Key Words: *Heavy metals, Physiology, Phenocopy, ecosystem, lentic, water bodies*

1. INTRODUCTION:

The quality of water present in aquatic environment is regarded as controlling factor for the state of health and productivity of different inhabitants residing within them (APHA,1999). Different populations present in water bodies is in perfect harmony with other population of different species and along with physical environment (Omolara et al., 2016). Any disturbance in both living and non-living factors of the ecosystem is regarded as ecological pollution. Pollution of the aquatic environment by inorganic and organic chemicals is a major factors posing serious threat to the survival of aquatic organisms such as fish, mollusc, insects etc (Cayrou, J. & R. Creghino ., 2005). The Lakes are an important natural resource for fish production in Bihar as specific freshwater fish are raised within them and supplied to the local market. In the meantime, the Lakes were subjected to a gradual shrinkage during the past few decades due to land reclamation and transformation of significant parts of the Lakes to fish farms, particularly along the southern regions. In addition, large parts of the Lakes are overgrown with aquatic vegetation which reduces the open water to nearly half of its total area, speeding up the process of land transformation (Oertli et al., 2005). Pollution of the aquatic environment by inorganic chemicals has been considered a major threat to the aquatic organisms including fishes (Tyagi et al., 2016). The agricultural drainage water containing pesticides and fertilizers and effluents of industrial activities and runoffs in addition to sewage effluents supply the water bodies and sediment with huge quantities of inorganic anions and heavy metals (ECDG, 2002). Along with this, one of the anthropogenic sources of metals are industrial, petroleum contamination and sewage disposal (Santos et al., 2005).

1.1. Review of literature:

In the Egyptian irrigation system, the main source of Cu and Pb are industrial wastes as well as algaecides (for Cu), while that of Cd is the phosphatic fertilizers used in crop farms (Mason, 2002). Lake sediments are normally the final pathway of both natural and anthropogenic components produced or derived to the environment (Roy, 2019). Sediment quality is a good indicator of pollution in water column, where it tends to concentrate the heavy metals and other organic pollutants (Venktesha et al., 2012). The present work aimed to investigate the levels of some heavy metals (Iron, Zinc, Copper and Manganese) in the water sediments of Udhwa and Simultalla lakes.

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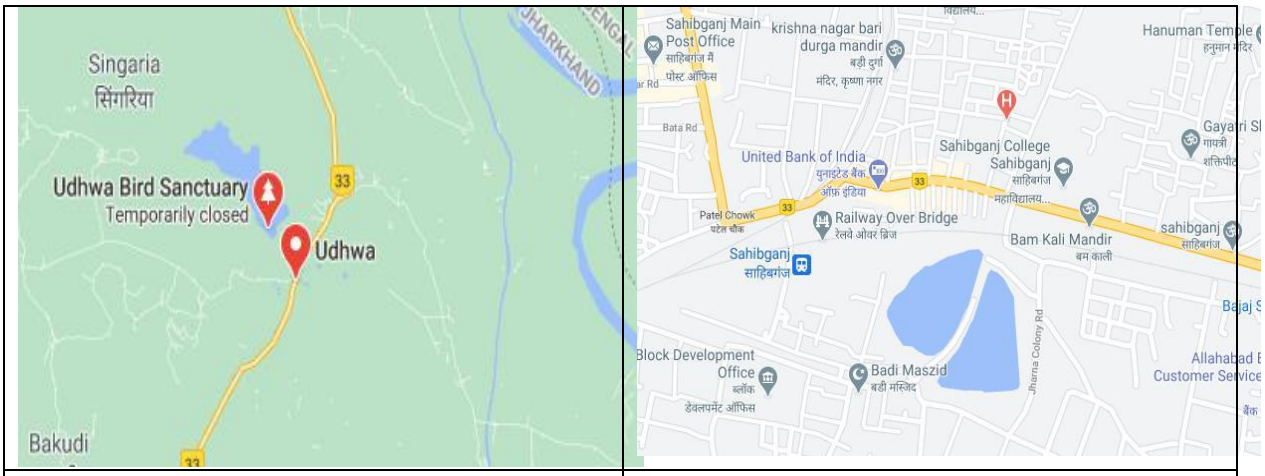


Fig. 1.0 Maps of Lakes (Udhwa and Simultalla) under study (courtesy: Google map).

Udhuwa or Udhwa Lake (24°59′37″N, 87°49′21″E) locally called Patauda Lake is situated in the Sahebganj district of the state of Jharkhand. Udhwa is named after saint Uddhava of Mahabharat times, a friend of Lord Krishna. It falls within the Gangetic Plains bio-geographic zone. The Sanctuary has two water bodies i.e. Patauran (155 ha) and Berhale (410 ha), interconnected by a water channel. Patauran is a comparatively clean water body with an average depth of about 2 m whereas Berhale is shallow with an average depth of about 70 cm. Berhale is largely covered by aquatic vegetation with small pockets of clear water while Pataura is surrounded by hillocks and plantations. The Sanctuary is connected to Ganga River through a 25 km long water channel known as the Udhuwa Nala, at Farraka. The area receives an average annual rainfall of 1000 mm and the temperature varies between 13°C to 40°C. Simultala lake is also situated in Sahebganj district of Jharkhand of Santhal Pargana. This division is located between $86^0 28^{'}$ and $87^0 37'$ east longitude and between $23^0 40'$ $25^0 18'$ North latitude. The climate of Shahibganj (Santhal Pargana) is characterized by hot summer and pleasant winter, which start in November and lasts till February. The period of march to first week of June is the summer season and this followed by the south-west monsoon season which lasts till end of September. Metal ions can be incorporated into food chains and concentrated in aquatic organisms to a level that affects their physiological state. Of the effective pollutants are the heavy metals which have drastic environmental impact on all organisms. Trace metals such as Zn, Cu and Fe play a biochemical role in the life processes of all aquatic plants and animals; therefore, they are essential in the aquatic environment in trace amounts (Roy, 2010).

2. MATERIALS AND METHODS:

Sampling area of the Udhwa and Simultala Lakes were shallow, brackish water bodies with a depth ranged from 50 to 180 cm. Lake Udhwa and Lake Simultalla are subject to huge inputs of terrigenous and anthropogenic nutrients discharge, sewage and agricultural runoff. Sediment samples were collected from Lake Udhwa (n = 13) and Lake Simultalla (n = 20), during 2013 for measuring heavy metals residues. Sediment samples were taken at different places at each station by a PVC tube column sampler at depth of half meter from the bottom surface. The samples at each station were mixed in a plastic bucket and common sample was placed in a polyethylene bags, kept refrigerated and transferred cold to the laboratory for analysis (Boyd and Tucker, 1992). Water Heavy metals in samples were extracted with conc. HCl and preserved in a refrigerator till analysis for Fe, Zn, Cu and Mn (Parker, 1972). The sediment samples were dried at 105 ºC, grinding, sieving and about (1.0 gm) of the most fine dried grains were digested with a mixture of conc. H_2O_2, HCl and HNO_3 as the method described in Page et al. (1982) and preserved in a refrigerator till analysis. Atomic Absorption Spectrophotometer (Model Thermo Electron Corporation, S. Series AA Spectrometer with Gravities furnace, UK,) instrument was used to detect the heavy metals. The concentrations of heavy metals were expressed as ppm for Statistical analysis One-way ANOVA. A probability at level of 0.05 or less was considered significant (Bailey, 1981). Standard errors were also estimated.

3. RESULTS AND DISCUSSION

Heavy metals present in Udhwa lake sediments were illustrated in Table 1.0. Metals concentrations in sediment sample were found in the following order: Fe > Mn > Cu > Zn. The maximum quantity of Fe (18.37 ppm) is followed by Mn (8.16 ppm) and then Cu (5.19 ppm). All the metals except Zn under investigation were found in higher quantity then than normal prescribed level.

Table 1.0: Heavy Metals present in sediments of Udhwa Lake (n= 13)

Sr.No.	Parameters	Observed Value (ppm) (Mean)	Reference value (ppm)	Comment
1.	Electrical Conductivity (EC)	0.117 ds/m	0.03-5.0 ds/m	Normal
2.	DTPA-Fe	18.37	0.100-1.00	High
3.	DTPA-Cu	5.19	0.100-1.00	High
4.	DTPA-Zn	0.86	0.45-2.03	Normal
5.	DTPA-Mn	8.16	0.500-1.00	High

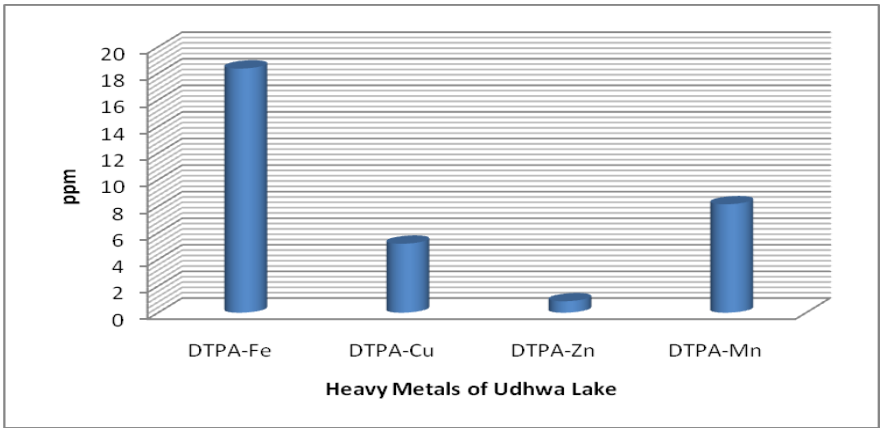


Figure 2: Amount of Heavy Metals in ppm of Udhwa Lake sediments

Similarly, Table 2.0 shows the quantity of heavy metals present in the sediments of Simultalla lake, Jharkhand. A total of twenty site samples (n=20) were used for the estimation of heavy metals. All the four heavy metals under study were detected successfully in sediment samples. The pattern was very similar to that of Udhwa lake but with varied quantity. Iron was found as major heavy metal (21.66 ppm) present followed by Mn (13.00 ppm) and then by Cu (6.07 ppm). Zinc (Zn) was found in the reference range of normal level. The electrical conductivity of the water samples from the twenty study sites were found to have a mean value of 0.114 deciSiemens per meter (dS/m) that falls under the reference range (0.03-5.0 deciSiemens per meter).

Table 2: Heavy Metals present in sediments of Simultalla Lake (n= 20)

Sr.No.	Parameters	Observed Value (ppm) (Mean)	Reference value (ppm)	Comment
1.	Electrical Conductivity (EC)	0.114 ds/m	0.03-5.0 ds/m	Normal
2.	DTPA-Fe	21.66	0.100-1.00	High
3.	DTPA-Cu	6.07	0.100-1.00	High
4.	DTPA-Zn	1.12	0.45-2.03	Normal
5.	DTPA-Mn	13.00	0.500-1.00	High

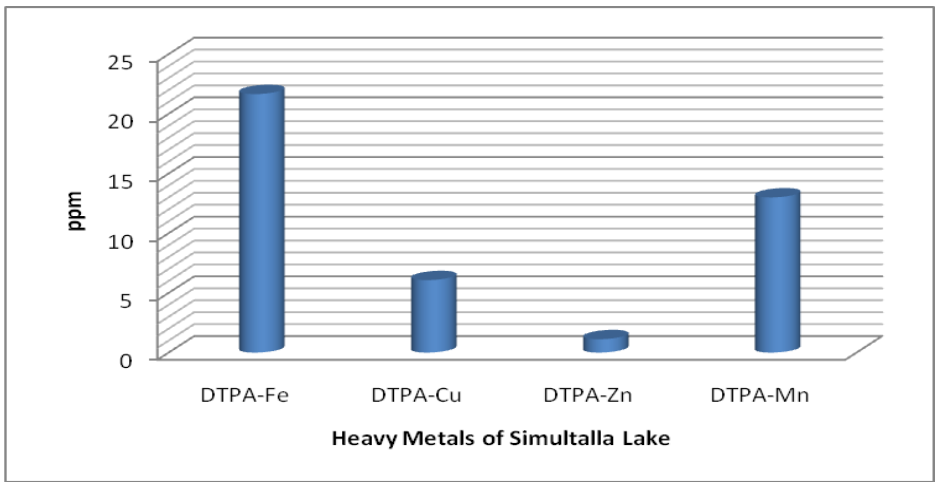


Figure 3: Amount of Heavy Metals in ppm of Simultalla Lake sediments

The difference in heavy metal quantity and there significant differences is depicted through Table 3.0. There is no significant difference is observed about the electrical conductivity of water samples of two different lakes. Amount of iron was found in much higher amount in lake Udhwa sediment samples with respect to Simultalla Lake sediments and thus have a significant level of difference as tested statistically. Similarly, Zn and Mn showed highly significant difference for the quantity suggesting different pattern of mineral enrichment in both the two lakes under study. The amount of Zn was found to have very less difference in their quantity in the sediment samples of both Udhwa and Simultalla Lakes as compared with other heavy metals.

Table 3: Differences in Heavy Metal amounts of Udhwa and Simultalla Lake sediments

Sr.No.	Parameters (ppm)	Udhwa Lake (n=13)	Simultala Lake (n=20)	Significant Difference (p≤0.5)
1.	Electrical Conductivity (EC)	0.117 ds/m	0.114 ds/m	Not Significant
2.	DTPA-Fe	18.37	21.66	***
3.	DTPA-Cu	5.19	6.07	**
4.	DTPA-Zn	0.86	1.12	***
5.	DTPA-Mn	8.16	13.00	***

(* = Significant & ** = Highly Significant)

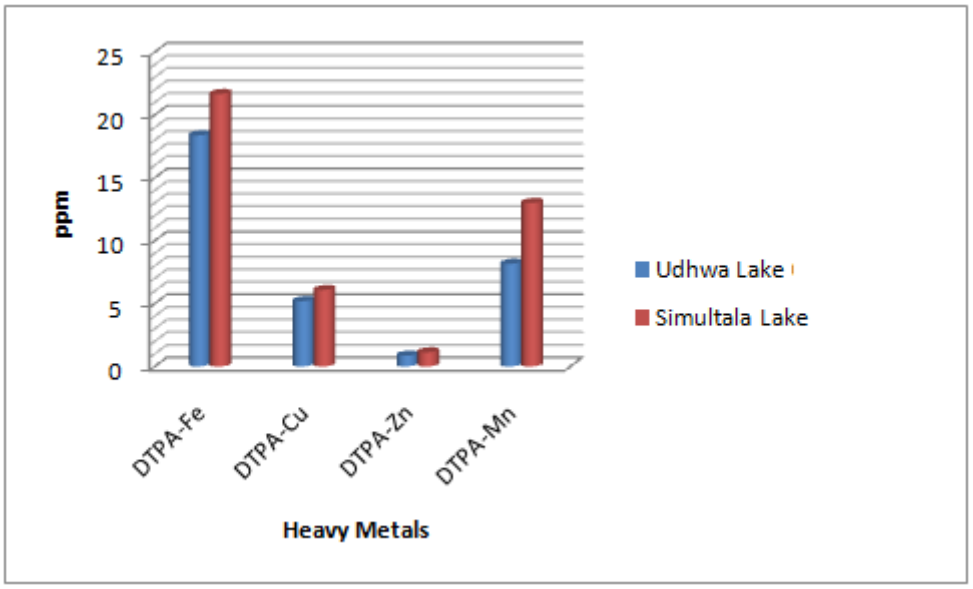
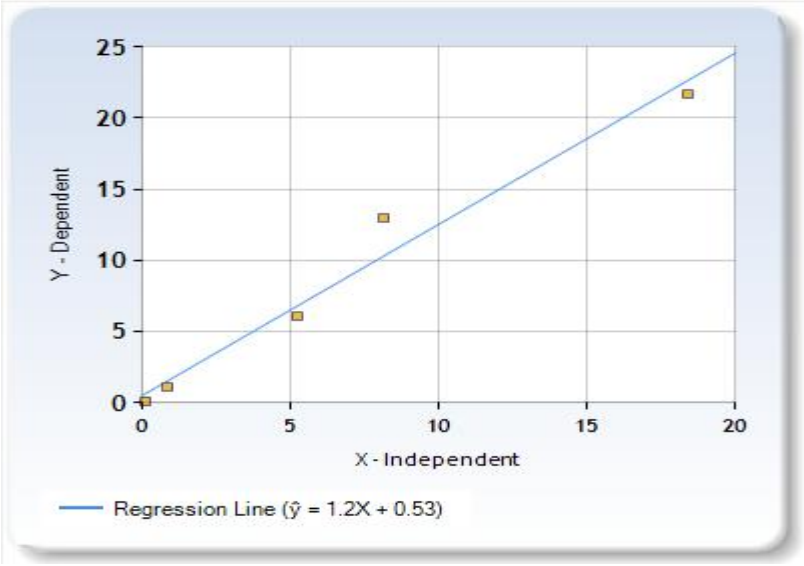


Figure 4: Comparative graph of heavy metals of Udhwa and Simultalla Lake sediments



Graph 1: Simple Linear line Regression between a.ounts of Heavy metals in Udhwa Lake (Y- axis) and Simultalla Lake (X- axis)

4. CONCLUSION:

It is concluded that both Udhwa and Simultalla lakes has heavy deposition of heavy metals. This may be attributed to the huge amounts of raw sewage, agricultural and industrial wastewater discharged into the Lake (Chakravarty and Patgiri; 2016). Beliles (1979) mentioned that the major sources for manganese in air and water are iron and steel manufacturing and the burning of diesel fuel in the motor cars. These heavy metals can easily interfere with the physiology of inhibiting animals and adversely affect them. In spite of man-made pollution, slow but continuous leaching of heavy metals from the bed rocks of water charging aquifers and in very little amount due to geological movements of bed rock during earthquakes.

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